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**US-A- 3 200 819**  
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## Description

The present invention concerns a smoking device.

Among the reasons why many people smoke conventional cigarettes or a tobacco pipe is that they wish to inhale an aerosol that contains nicotine. However, when a cigarette is smoked, some nicotine is lost to the smoker by pyrolysis and some is lost in sidestream smoke, mainly during smoulder between puffs.

The present invention provides a smoking device in which the loss of nicotine to the smoker by pyrolysis and in sidestream smoke is substantially avoided.

A prior art smoking device which aims at minimising the above-mentioned disadvantage is described in US-A-3356094 in the name of C.D. Ellis et al. This smoking device comprises a tube formed of tobacco having a mouthpiece attached at one end. An axial inner tube of material which is frangible under heat is contained within the tobacco tube and is coated on its inner surface with nicotine. Thus, on smoking, hot gases are drawn up the inner tube and, acting on the nicotine, release the nicotine in the form of an aerosol for inhalation by the smoker. However, appreciable loss of nicotine and other desirable compounds such as flavourants during smoking is not entirely prevented.

A further prior art smoking device described in GB-A-2064296 (Imperial Tobacco Limited) has an annular fuel rod with longitudinal bore in gaseous communication with a mouth-end chamber. The chamber contains a quantity of inhalant material which, when contacted by hot gases during smoking forms an aerosol for inhalation by the smoker.

Also, a smoking device described in EP-A-174645 (R.J. Reynolds Tobacco Company), which is believed to be the closest prior art, comprises a short combustible carbonaceous fuel element, a heat stable substrate bearing an aerosol forming substance (aerosol generating means), a heat conducting member which contacts a portion of the fuel element and the substrate, and an insulating jacket surrounding at least a portion of the fuel element, the object being to provide a smoke-like aerosol which is chemically simple, consisting essentially of air, oxides of carbon, water, and the aerosol which carries any desired flavourants or other desired volatile materials.

These devices do not suffer the disadvantages of US-A-3356094 in that nicotine and other desirable compounds such as flavourants are not substantially lost during smoulder. However, yields of mainstream aerosol available to the smoker are generally not as high as in conventional cigarettes.

It is an objective of the present invention to provide a smoking device that attains the above-mentioned objectives of the prior art while affording scope to generate relatively higher yields of mainstream

aerosol. A particular feature of the present invention is that heat required to vaporise aerosol precursor, an event which precedes condensation to mainstream aerosol, is essentially transferred to the aerosol precursor by contact with heated surfaces rather than with hot gases as in the devices of the prior art.

According to the present invention there is provided a smoking device for releasing an aerosol into the mouth of a smoker, the device comprising in combination, a chamber into which air and an aerosol precursor are introduced and mixed, heating means external of the chamber for heating internal surfaces of the chamber, a first duct providing communication between the chamber and a smoker's mouth, whereby the contents of the chamber may be drawn into the smoker's mouth, a container for an aerosol precursor, a second duct means leading from the aerosol precursor container into the chamber whereby when the pressure in the chamber is reduced by the smoker drawing on the device, aerosol precursor may pass from said container into the chamber, and a third duct means providing communication between ambient air and the chamber whereby ambient air may be drawn into the chamber by the smoker, the arrangement being such that in operation the aerosol precursor and air mixture in the chamber is heated and then condenses to form a condensation aerosol.

The aerosol precursor is preferably a liquid.

The second and third duct means may have separate entrances into the chamber. The second and third duct means may alternatively be provided by coaxial second and third ducts respectively having a common entrance into the chamber.

The third duct may be provided with a constricted region thereby to provide a pressure drop in air passing therethrough.

The third duct means may be a capillary.

There may be provided a fourth duct means between the container and the ambient air whereby pressure within the container may be equalised with that of the ambient air.

The means for heating the internal surfaces of the chamber is preferably provided by a heat source surrounding the chamber into which said mixture is introduced.

The invention will now be described by way of example only with reference to the following schematic non-scale sectional drawings in which Figures 1, 2 and 3 respectively show first, second and third embodiments of a smoking device according to the invention.

Referring to the first embodiment illustrated in Figure 1 there is shown in longitudinal cross-section a pipe-like smoking device 10 comprising a cylindrical bowl member 12 divided into upper and lower compartments 14, 16 respectively by a partition 18, and a cylindrical mouthpiece 20 extending radially from the upper compartment through the cylindrical wall of the

upper compartment. The upper end of the upper compartment 14 is provided with a protective fireproof cover 22 of porous or perforated material. The lower compartment 16 is closed at its lower end except for an air inlet 24.

A tube 26 extends axially between the upper and lower compartments 14, 16 through the partition 18. A further tube 27 provides communication between the interior of the upper end 28 of the tube 26, which is otherwise closed, and the mouthpiece 20. The upper end of the tube 26 is further surrounded by a heat-generating device 30, to be described hereinafter, adapted to heat the internal surfaces of the tube and consequently the contents of the tube. The lower end 32 of the tube 26, within the lower compartment 16, is open so that air may enter from the inlet 24, and is further provided with a constriction or venturi 34 so as to increase the velocity of air passing through the lower part of the tube and thereby decrease the air pressure within the tube upstream of the venturi.

Within the lower compartment 16 there is provided a flexible container 36 containing a liquid aerosol precursor the composition of which will be discussed in greater detail below. The container 36 is provided with an outlet duct, in the form of a capillary tube 38, leading into the tube 26 upstream of the venturi 34 at an inlet 39. The optimum diameter of the capillary 38 depends upon both the pressure drop across the venturi 34 and the viscosity of the aerosol precursor.

Referring to the second embodiment illustrated in Figure 2 there is shown in longitudinal cross-section a cylindrical smoking device 40 resembling externally a traditional cigarette holder. The device 40 comprises an outer cylindrical pipe 242 open at both ends, one end tapering to a mouthpiece portion 244. That end of the outer cylindrical pipe 242 opposed to the mouthpiece 244 is provided with a protective tubular cover 222 of porous or perforated fireproof material. An aperture 224 is provided in the wall of the pipe 242 near the mouthpiece portion 244 so as to permit a flow of ambient air into the pipe.

An inner tubular member 226 supported by barrier 218, extends within the device 40 axially from the open end of the pipe 242 towards the mouthpiece 244. A further tube 227 provides communication between the interior of an end chamber portion 228 of the tube 226 distal to the mouthpiece 244, and the mouth end of the mouthpiece.

Accordingly, when a smoker draws on the device 40 through the mouthpiece 244 he is drawing on the contents of the end chamber 228 of tube 226. The barrier 218 may be porous or have holes, whence aperture 224 is not required.

The end chamber portion 228 is further surrounded by a heat-generating device 230, to be described hereinafter, adapted to heat the internal surfaces of the tube, and thereby the contents of the tube. The

other end 232 of the tube 226 is open so that air may enter from the inlet 224 or through barrier 218 and is provided with a constriction or venturi 234 so as to increase the velocity of air passing through the tube and thereby decrease the air pressure within the tube upstream of the venturi.

Within the pipe 242 there is provided a flexible container 236 containing a liquid aerosol precursor the composition of which will be discussed in greater detail below. The container 236 is provided with an outlet duct, in the form of a capillary tube 238, leading into and through the tube 226 at its open end 232 to terminate upstream of the venturi 234 at an inlet 239 within end chamber 228. The diameter of the capillary 238 is chosen to match the pressure drop across the venturi 234 and the viscosity of the aerosol precursor.

Referring to the third embodiment there is shown in Figure 3 in longitudinal cross-section a cylindrical smoking device 50 resembling in its external features a traditional cigarette holder. The device 50 comprises an outer cylindrical pipe 342 open at both ends, one end tapering to a mouthpiece portion 344. That end of the outer cylindrical pipe 342 opposed to the mouthpiece 344 is provided with a protective tubular extension or cover 322 of porous or perforated fireproof material. Located axially within the pipe 342 but spaced therefrom by a cylindrical air channel 350 is a rigid cylindrical chamber 336 made of an incombustible and gas-imperious material closed at the end nearest the mouthpiece portion 344. An aperture 324 is provided in the wall of the pipe 342 near the mouthpiece portion 344. The aperture 324 permits equalisation of air pressure within the rigid cylindrical chamber 336 with ambient air and is typically of small radial dimensions, e.g. 1 mm diameter. The rigid cylindrical chamber 336 is provided at the end nearest the mouthpiece portion 344 with a duct 325 communicating with the aperture 324 in the wall of the pipe. The end of the chamber 336 distal to the mouthpiece portion 344 tapers to a capillary passage 338 terminating in an exit aperture 339 lying within the overall length of the pipe 342 and its protective extension 322.

Within the chamber 336, positioned between the duct 325 and the capillary passage 338 is a means 337 for providing an aerosol precursor, such as a porous body impregnated with volatilisable liquid aerosol precursor.

Surrounding the capillary passage 338 and a portion of the chamber 336 but spaced therefrom by a cylindrical airway 352 communicating with air channel 350 is an incombustible and gas-imperious chamber 360 which follows generally the contours of the chamber 336 and the constricted passage 338 so that that portion of chamber 360 which surrounds said portion of chamber 336 is in sealing contact with the inner face of the pipe 342 and its protective extension 322 whereas that portion of the chamber 360 surrounding the capillary passage 338 is spaced from the inner

face of the extension 322. The chamber 360 is open at the end nearest the mouthpiece 344 and is provided at the end distal to the mouthpiece with an aperture 332 of about 0.84 mm diameter open to ambient air. That portion of the chamber 360 surrounding the capillary passage 338 provides a section 362 into which the exit aperture 339 discharges.

That end of the chamber 360 surrounding the capillary passage 338 is surrounded by a cylindrical heat generating device 330, to be described below, located within the protective extension 322 and adapted to heat the internal surfaces of that portion of the chamber 360 surrounding the capillary passage 338 and the capillary passage itself.

In operation of the embodiment of Figure 3 the smoker draws on the mouthpiece 344 thereby creating a reduced pressure in chamber 362 with which the mouthpiece is in communication. The reduced pressure causes aerosol precursor to be drawn through the heated capillary passage 338 and to be propelled from the exit aperture 339 on to the heated internal surfaces of chamber 362. Aerosol precursor is thereby vaporised and the vapour is synchronously mixed with air that is caused by the reduced pressure in chamber 362 to be drawn into said chamber through aperture 332. The vapour and air mixture is drawn through the air way 352 into channel 350 and into mouthpiece 344 where cooling results in formation of a condensation aerosol. Hence aerosol is drawn into the smoker's mouth.

In the above embodiments the heat-generating device 30, 230, 330 is an exothermic material such as a mixture of inorganic solids which generate heat exothermically on ignition. Examples of such exothermic mixtures are mixtures of iron oxide and calcium silicide and mixtures of iron and sulphur.

The heat-generating device 30, 230, 330 may alternatively consist of a substance that relies on air oxidation for continued generation of heat after ignition. One example of such a substance is a carbonaceous mixture containing carbon, a binder such as xanthan gum, and an inorganic oxidizing agent such as potassium nitrate. One composition of the mixture contemplated is 2% potassium nitrate, 10% xanthan gum and 88% carbon.

Other examples of heat-generating substances include hydrogen, and gaseous or volatile hydrocarbons. Ambient air will be available through the open end of the device or through perforations or regions of porosity in the respective protective cover 22, 222, 322, or, in the case of the first embodiment, through an aperture or apertures in the external wall of the upper compartment 14.

The aforesaid exothermic mixture, carbonaceous material, hydrogen or gaseous or volatile hydrocarbons may be adapted to be ignited by a heat source provided by the user.

The heat-generating device may include a primer

or a friction element. Hydrogen may be ignited catalytically (by platinum/palladium catalyst), as may the gaseous or volatile hydrocarbons on warming.

An alternative embodiment of the heat-generating device 30, 230, 330 may be an electric heater powered by a battery. The electric heater, hydrogen and gaseous or volatile hydrocarbons may have puff actuated ignition.

The aerosol precursor within the flexible containers 36, 236 of respective Figures 1 and 2 comprises a liquid base having a boiling point in the range 100°-300°C, e.g. glycerol, propylene glycol, or sebacate esters such as di-2-ethylhexyl sebacate. The liquid base may also contain water, flavouring agents, nicotine or salts thereof.

When nicotine is incorporated in the aerosol precursor its concentration is chosen such that the level of nicotine in an aerosol produced from the precursor is similar to that attained by smokers when smoking conventional smoking products containing tobacco, e.g. in the range 20-200 micrograms per puff.

#### Claims

1. A smoking device (10) for releasing an aerosol into the mouth of a smoker, the device comprising in combination,

- (a) a chamber (28) into which air and an aerosol precursor are introduced and mixed,
- (b) heating means (30) external of the chamber (28) for heating internal surfaces of the chamber (28),
- (c) a first duct (20) providing communication between the chamber (28) and a smoker's mouth, whereby the contents of the chamber may be drawn into the smoker's mouth,
- (d) a container (36) for an aerosol precursor,
- (e) a second duct means (38) leading from the aerosol precursor container (36) into the chamber (28) whereby when the pressure in the chamber is reduced by the smoker drawing on the device, aerosol precursor may pass from said container into the chamber, and
- (f) a third duct means (32) providing communication between ambient air and the chamber (28) whereby ambient air may be drawn into the chamber by the smoker the arrangement being such that in operation the aerosol precursor and air mixture in the chamber is heated and then condenses to form a condensation aerosol.

2. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT the aerosol precursor is a liquid.

3. A smoking device as claimed in claim 1

CHARACTERIZED IN THAT the container (36) for the aerosol precursor is a flexible container.

4. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT the second and third duct means (38, 32) are provided by second and third ducts respectively, having separate entrances into the chamber (28).

5. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT the second and third duct means are provided by coaxial second and third ducts (238, 232) respectively having a common entrance into the chamber (228).

6. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT the third duct (32) is provided with a constricted region (34) to provide a pressure drop in air passing therethrough.

7. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT a fourth duct means (324) is provided between the container and the ambient air whereby pressure within the container may be equalised with that of the ambient air.

8. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT the means for heating the mixture of aerosol precursor and air is provided by a heat source surrounding the chamber containing said mixture.

9. A smoking device as claimed in claim 1 CHARACTERIZED IN THAT the aerosol precursor comprises a liquid base having a boiling point in the range 100°-300°C.

10. A smoking device as claimed in claim 9 CHARACTERIZED IN THAT the liquid base is selected from the group consisting of glycerol, propylene glycol, and sebacate esters.

#### Patentansprüche

1. Rauchvorrichtung (10) zum Freigeben eines Aerosols in den Mund eines Rauchers, gekennzeichnet durch die Kombination folgender Merkmale

- eine Kammer (28), in die Luft und ein Aerosolvorläufer eingeführt und gemischt werden
- eine Aufheizvorrichtung (30) außerhalb der Kammer (28) zum Aufheizen von Innenflächen der Kammer (28)
- eine erste Leitung (20), die eine Verbindung zwischen der Kammer (28) und dem Mund eines Rauchers herstellt, wobei der Inhalt der Kammer in den Mund des Rauchers eingesaugt werden kann,
- einen Behälter (36) für einen Aerosolvorläufer
- eine zweite Leitungsvorrichtung (38), die von dem Aerosolvorläuferbehälter (36) in die Kammer (28) führt, wobei dann, wenn der Druck in der Kammer dadurch reduziert wird, daß der Raucher an der Vorrichtung zieht, Aerosolvor-

läufer von dem Behälter in die Kammer gelangen kann, und

- eine dritte Leitungsvorrichtung (32), die eine Verbindung zwischen der Umgebungsluft und der Kammer (28) ergibt, wobei Umgebungsluft vom Raucher in die Kammer eingesaugt werden kann, und wobei die Anordnung so gewählt ist, daß im Betrieb der Aerosolvorläufer und das Luftgemisch in der Kammer erhitzt und dann zur Bildung eines Kondensationsaerosols kondensiert wird.

2. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Aerosolvorläufer eine Flüssigkeit ist.

3. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Behälter (36) für den Aerosolvorläufer ein flexibler Behälter ist.

4. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die zweite und die dritte Leitungsvorrichtung (38, 32) durch zweite und dritte Leitungen mit getrennten Eingängen in die Kammer (28) versehen sind.

5. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die zweite und die dritte Leitungsvorrichtung koaxiale zweite und dritte Leitungen (238, 232) sind, die einen gemeinsamen Eingang in die Kammer (228) haben.

6. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die dritte Leitung (32) einen verengten Bereich (34) aufweist, um einen Druckabfall in der hindurchströmenden Luft zu erzielen.

7. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß eine vierte Leitungsvorrichtung (324) zwischen dem Behälter und der umgebenden Luft vorgesehen ist, wobei der Druck inner halb des Behälters mit dem der umgebenden Luft egalisiert ist.

8. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Vorrichtung zum Aufheizen des Gemisches des Aerosolvorläufers und der Luft durch eine Wärmequelle ausgebildet ist, die die das Gemisch enthaltende Kammer umgibt.

9. Rauchvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß der Aerosolvorläufer eine flüssige Basis mit einem Siedepunkt im Bereich von 100° bis 300°C aufweist.

10. Rauchvorrichtung nach Anspruch 9, dadurch gekennzeichnet, daß die flüssige Basis aus der Gruppe ausgewählt ist, die aus Glycerol, Propylenglycol und Sebacateestern besteht.

#### Revendications

- Dispositif pour fumer (10) apte à relâcher un aerosol à l'intérieur de la bouche d'un fumeur, ce dispositif comprenant en combinaison :

- (a) une chambre (28) à l'intérieur de laquelle de l'air et un précurseur d'aérosol sont introduits et mélangés,
- (b) des moyens de chauffage (30) externes à la chambre (28) aptes à chauffer les surfaces internes de la chambre (28),
- (c) une première conduite (20) permettant la communication entre la chambre (28) et une bouche du fumeur, de sorte que le contenu de la chambre peut être aspiré à l'intérieur de la bouche du fumeur,
- (d) un récipient (36) pour un précurseur d'aérosol,
- (e) des seconds moyens formant conduite (38) s'étendant depuis le récipient à précurseur d'aérosol (36) jusqu'à l'intérieur de la chambre (28) de sorte que si la pression dans la chambre est réduite par l'aspiration du fumeur sur le dispositif, le précurseur d'aérosol peut passer depuis ledit récipient jusqu'à l'intérieur de la chambre, et
- (f) des troisièmes moyens formant conduite (32) qui permettent la communication entre l'air ambiant et la chambre (28), de sorte que l'air ambiant peut être aspiré à l'intérieur de la chambre par le fumeur, cet arrangement étant tel que lors du fonctionnement, le mélange de précurseur d'aérosol et d'air dans la chambre est chauffé et ensuite se condense pour former une condensation d'aérosol.

2. Dispositif pour fumer selon la revendication 1, caractérisé en ce que le précurseur d'aérosol est un liquide.

3. Dispositif pour fumer selon la revendication 1, caractérisé en ce que le récipient (36) pour le précurseur d'aérosol est un récipient flexible.

4. Dispositif pour fumer selon la revendication 1, caractérisé en ce que les second et troisième moyens formant conduite (38, 32) sont pourvus de seconde et troisième conduites, respectivement, ayant des entrées séparées à l'intérieur de la chambre (28).

5. Dispositif pour fumer selon la revendication 1, caractérisé en ce que les second et troisième moyens formant conduites sont prévus par des seconde et troisième conduites coaxiales (238, 232) ayant respectivement une entrée commune à l'intérieur de la chambre (228).

6. Dispositif pour fumer selon la revendication 1, caractérisé en ce que la troisième conduite (32) est prévue avec une région resserrée (34) pour obtenir une chute de pression de l'air passant au travers de celle-ci.

7. Dispositif pour fumer selon la revendication 1, caractérisé en ce que des troisièmes moyens formant conduite (324) sont prévus entre le récipient et l'air ambiant, de sorte que la pression à l'intérieur du récipient peut être rendue égale avec celle de l'air

ambiant.

7. Dispositif pour fumer selon la revendication 1, caractérisé en ce que les moyens de chauffage du mélange de précurseur d'aérosol et d'air sont prévus par une source de chaleur qui entoure la chambre contenant ledit mélange.

9. Dispositif pour fumer selon la revendication 1, caractérisé en ce que le précurseur d'aérosol comprend une base liquide ayant un point d'ébullition dans une gamme entre 100°-300°C.

10. Dispositif pour fumer selon la revendication 9, caractérisé en ce que la base liquide est choisie dans un groupe comprenant le glycérol, le glycol propylène et les esters sébacates.

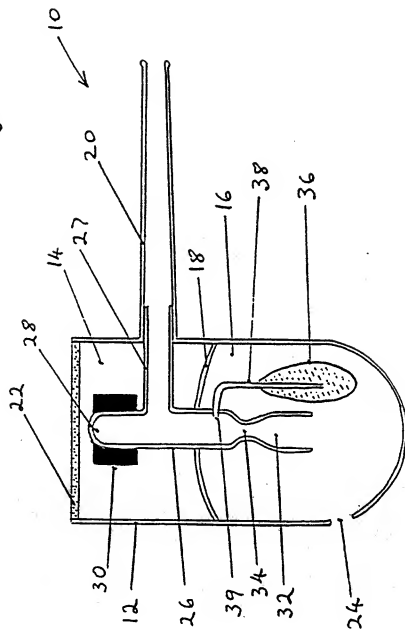
Fig. 1

Fig. 2

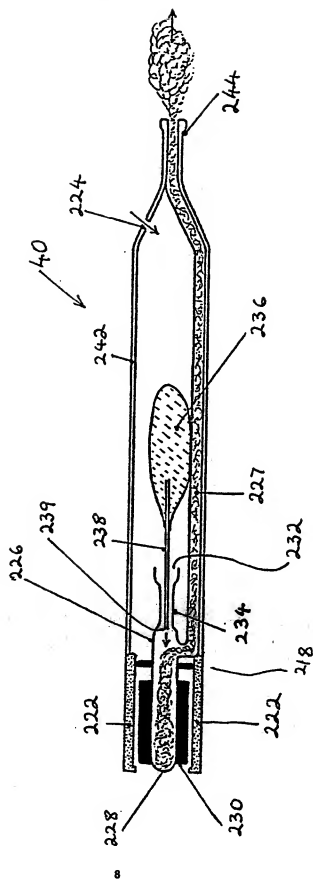




Fig. 3

